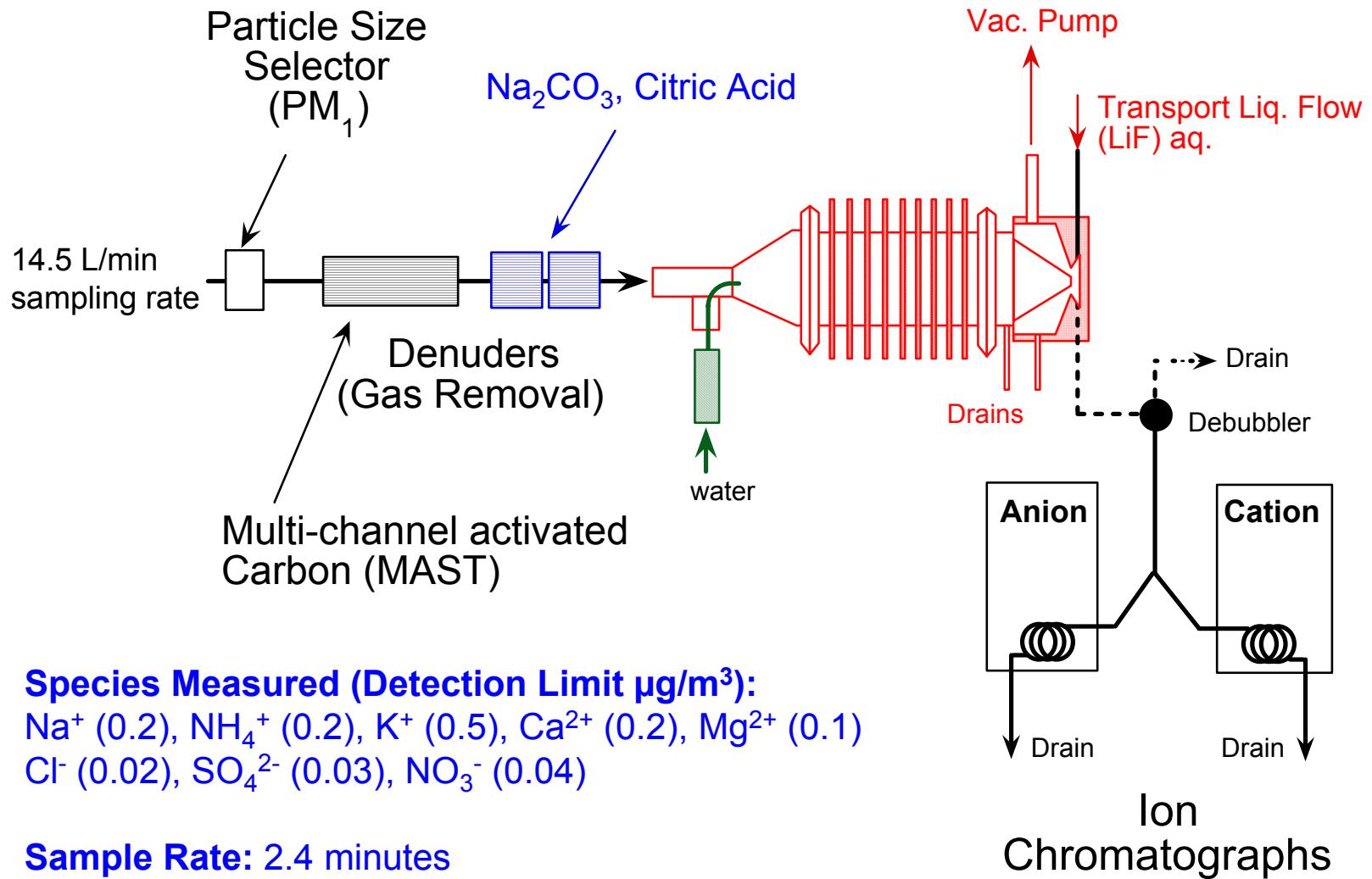


Measurements of Fine Aerosol Inorganic Composition

Chris Hennigan, Scott Sandholm, Rodney Weber
March 2005



Method: PILS-IC



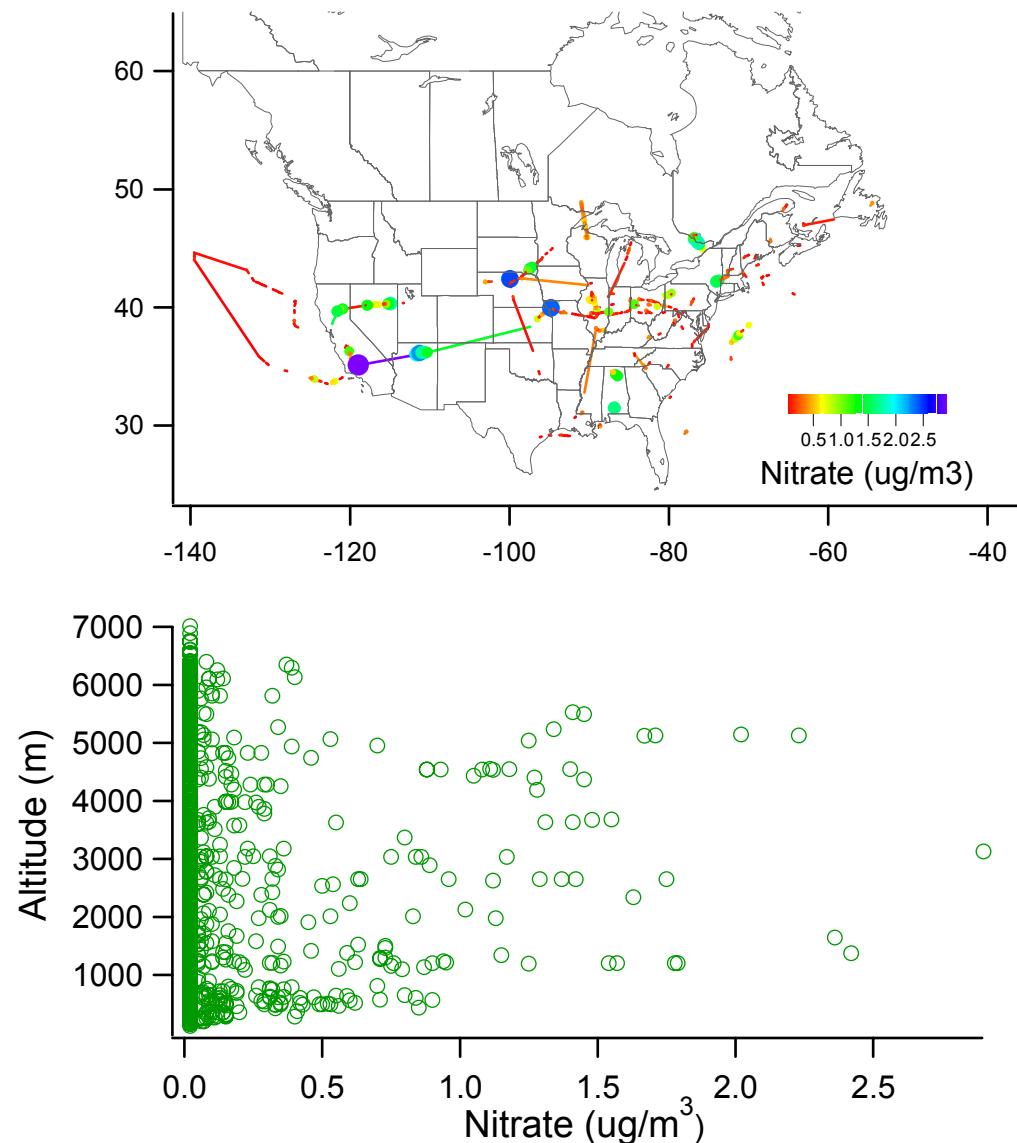
Fine Particle (PM1.0) INTEX-NA Concentrations

All Data: $\mu\text{g}/\text{m}^3$ at 20°C 1 atm

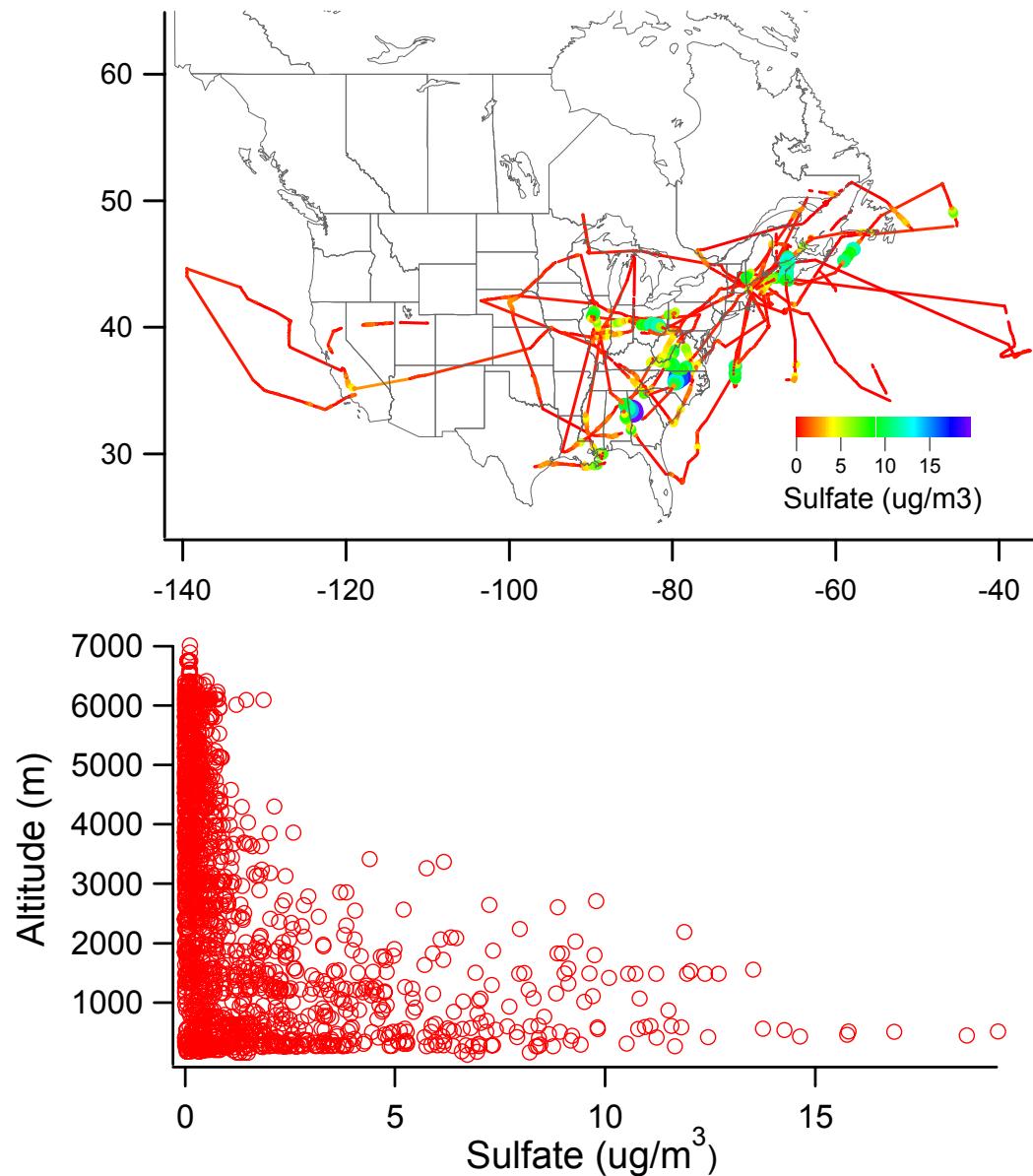
| | Mean | Standard Dev. | Min (LOD/2) | Max |
|--------------------|------|---------------|-------------|-------|
| Na^+ | 0.11 | 0.15 | 0.10 | 4.35 |
| NH_4^+ | 0.92 | 1.33 | 0.10 | 8.28 |
| Ca^{2+} | 0.11 | 0.14 | 0.10 | 4.15 |
| K^+ | 0.25 | 0.18 | 0.25 | 7.66 |
| Mg^{2+} | 0.05 | 0.05 | 0.05 | 1.90 |
| Cl^- | 0.02 | 0.11 | 0.01 | 4.34 |
| NO_3^- | 0.09 | 0.26 | 0.02 | 2.90 |
| SO_4^{2-} | 1.38 | 2.39 | 0.02 | 19.35 |

- Na^+ , Ca^{2+} , K^+ , Mg^{2+} , Cl^- all near/below LOD throughout mission
- **SO_4^{2-} dominate ionic component**

NO_3 Spatial Distribution (DC-8)

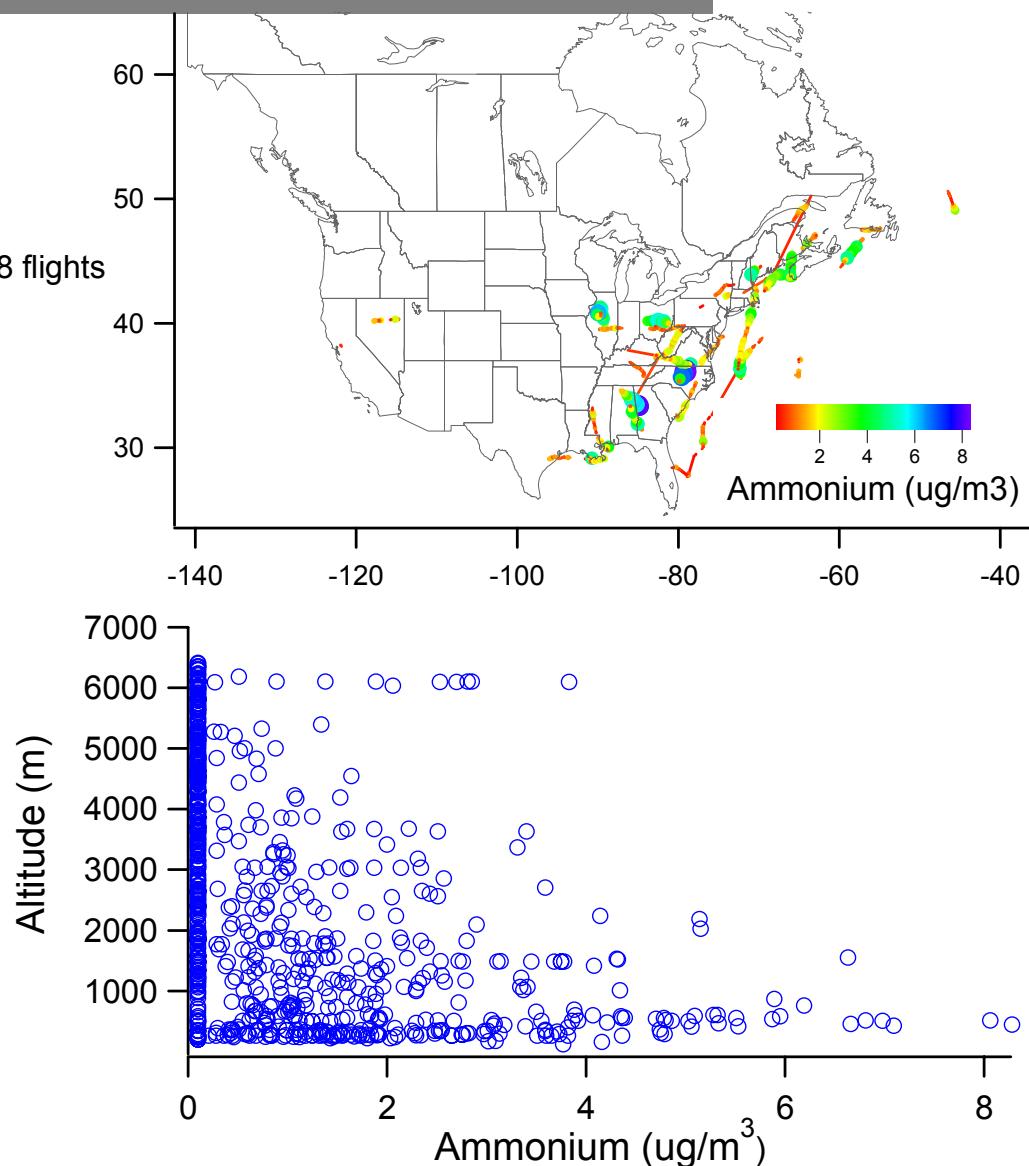


$\text{SO}_4^=$ Spatial Distribution (DC-8)

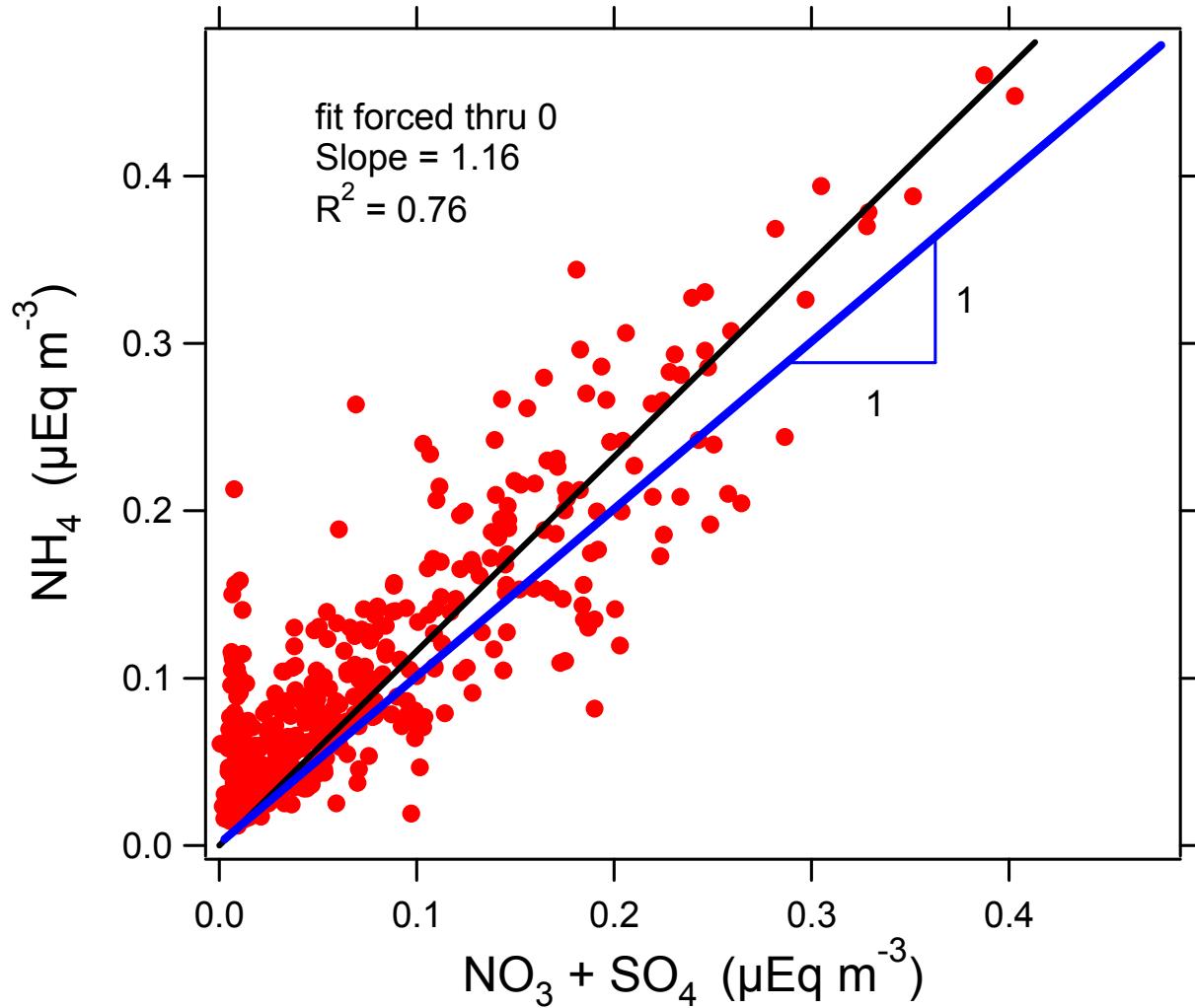


NH₄ Spatial Distribution (DC-8)

Ammonium data for 9 of 18 flights

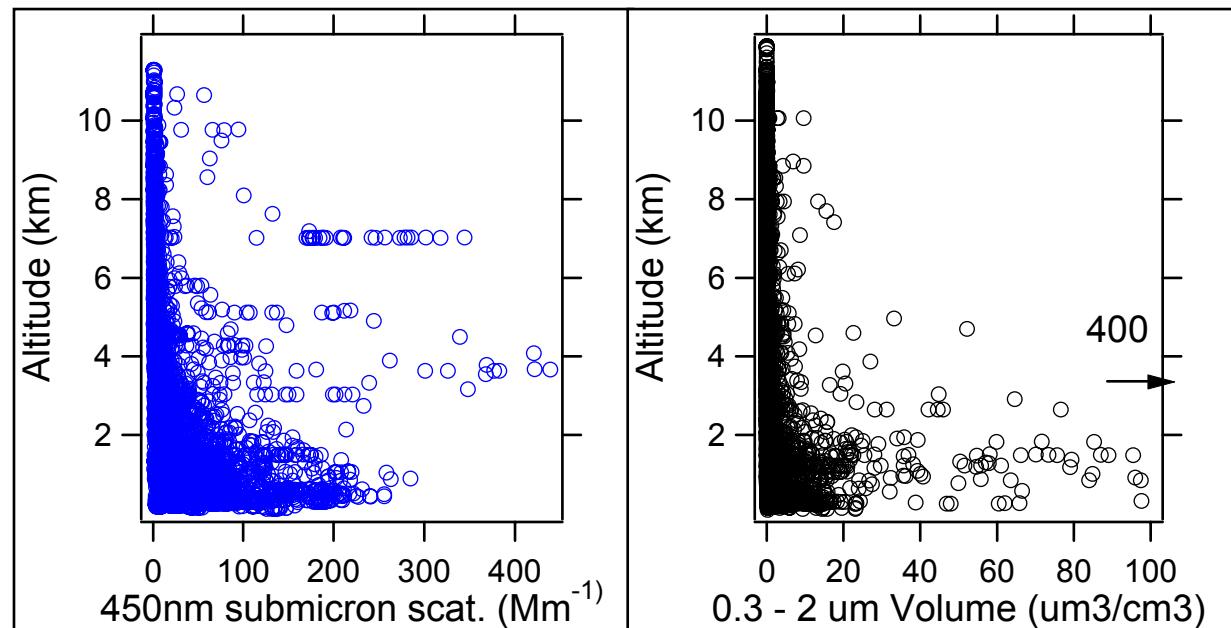
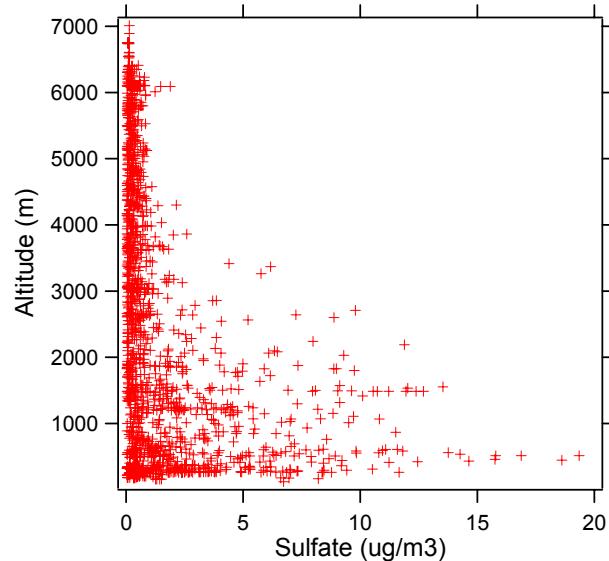


Aerosol apparent acidity: $(\text{NH}_4)_2\text{SO}_4$



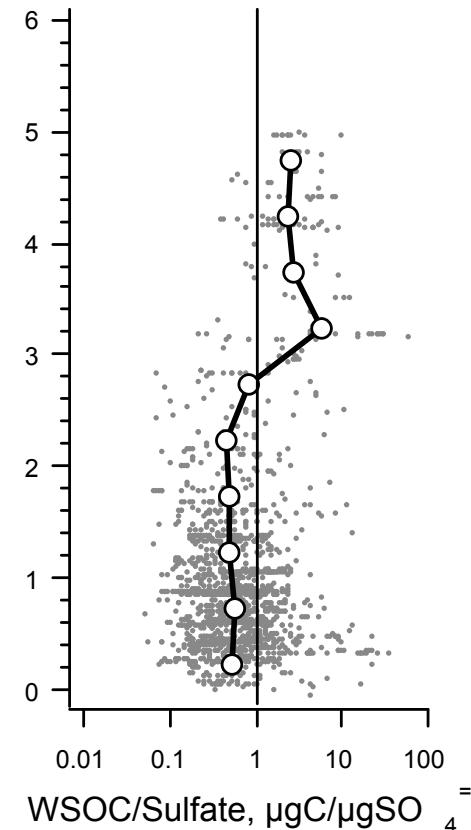
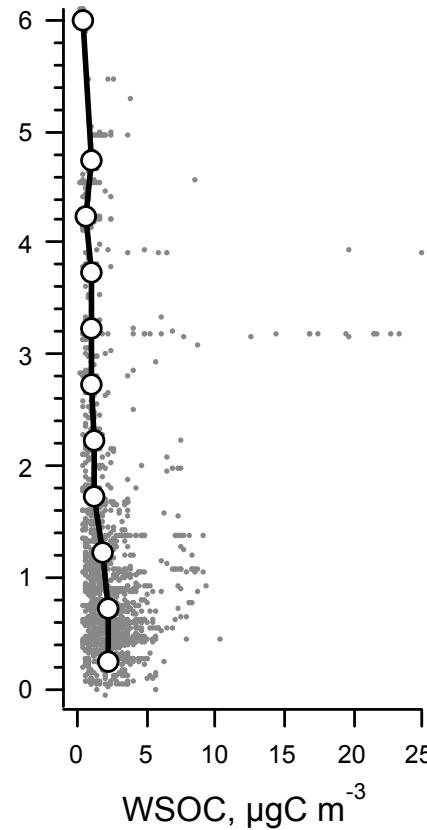
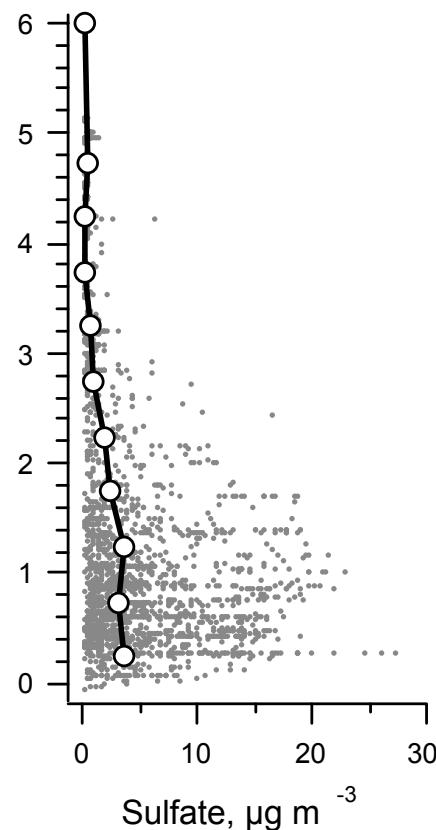
SO_4^{\cdot} :

- dominant ionic species
- highest in 0-2 km alt.
- High scattering, vol.



NOAA P3 Results: Similar but Different

- $\text{SO}_4^{\text{=}}$ dominates inorganic
- Highest at low altitudes

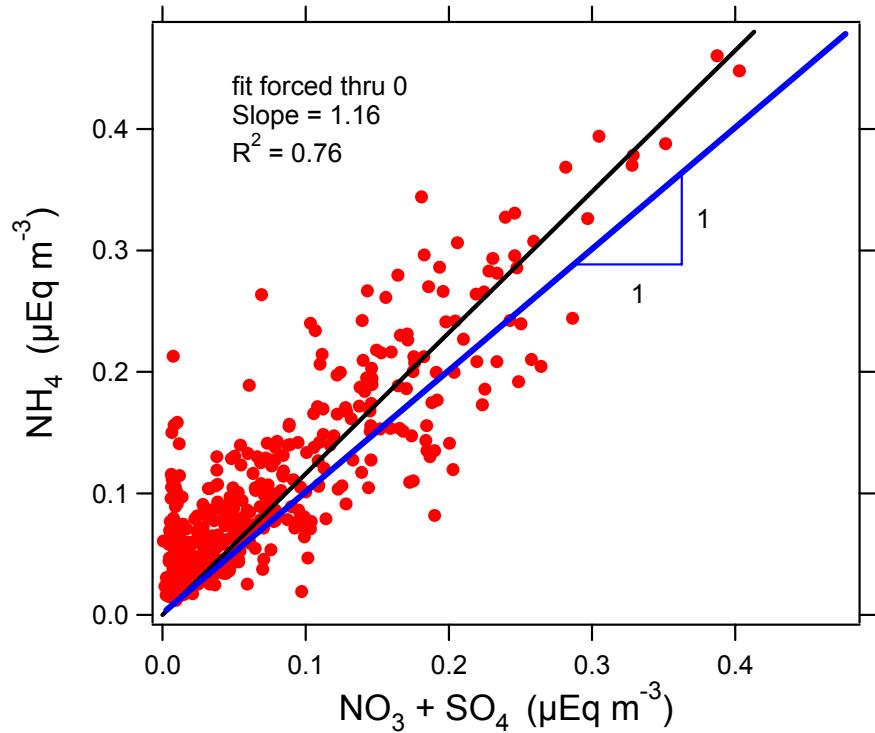


NOAA P3: ITCT 2K4

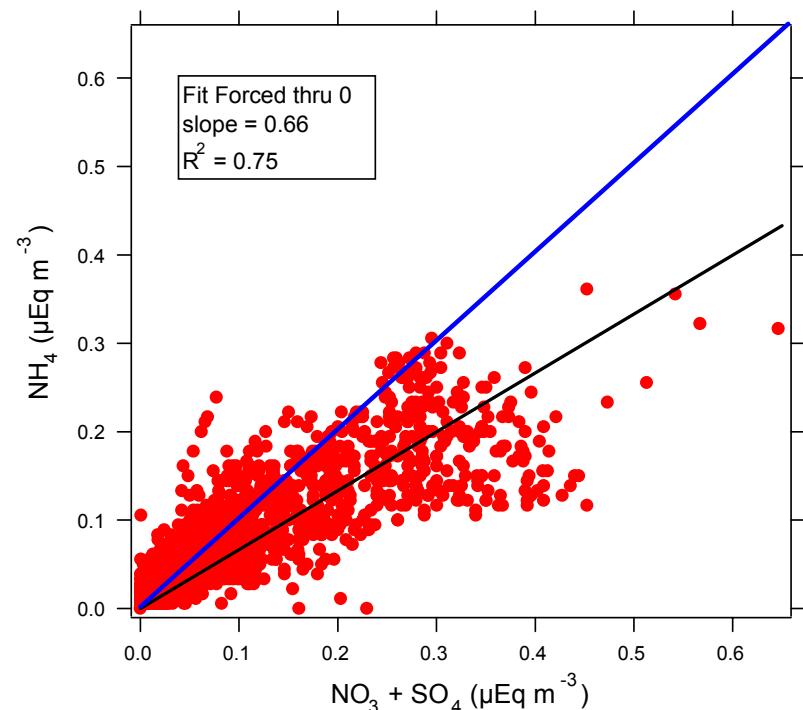
NOAA P3 Results: Similar but Different

– Not as neutralized

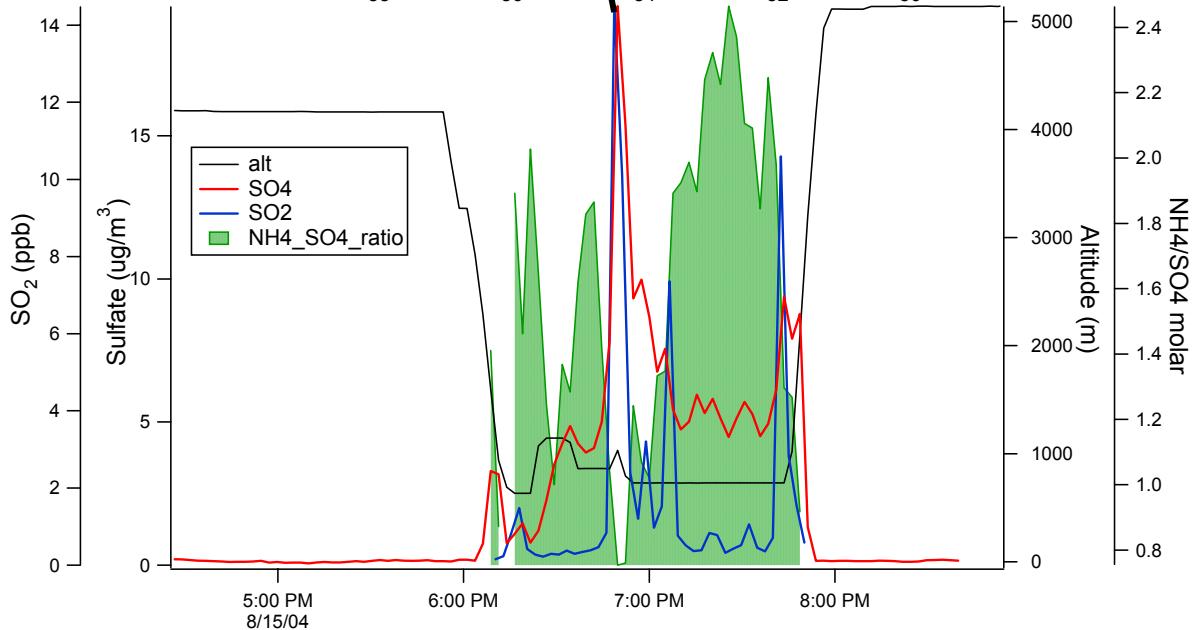
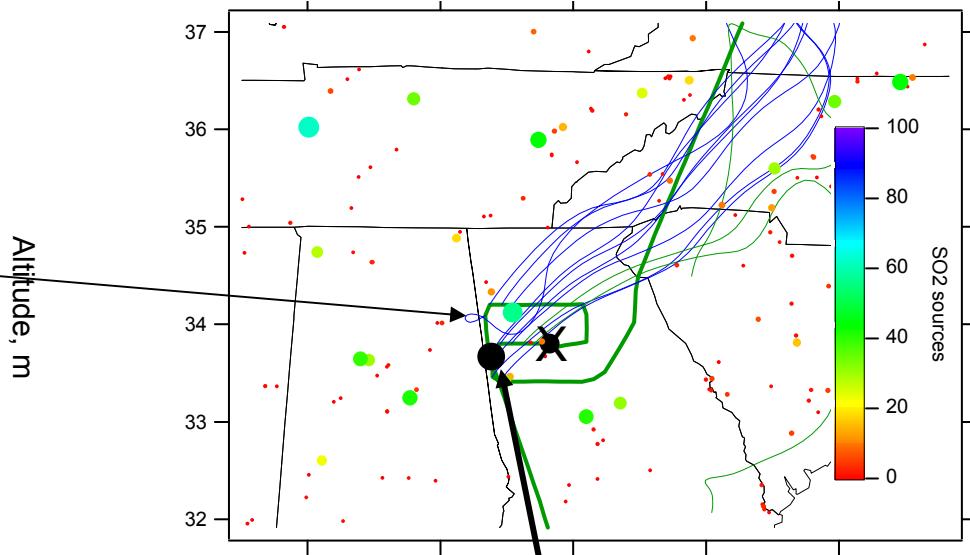
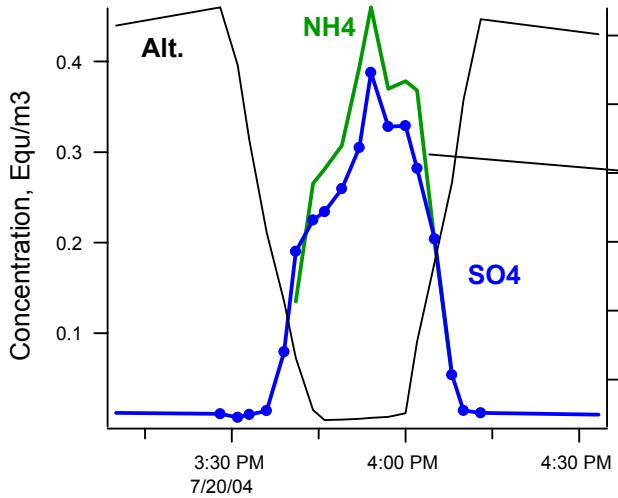
NASA DC-8



NOAA P3



NOAA P3: More Detailed Studies of Specific Plumes

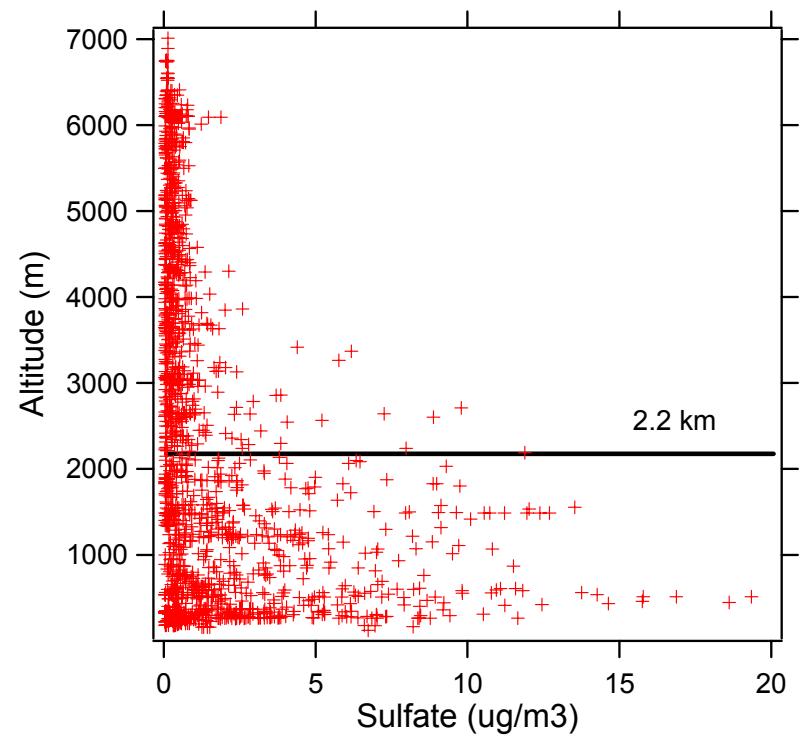


Weber et al. JAWMA 2003

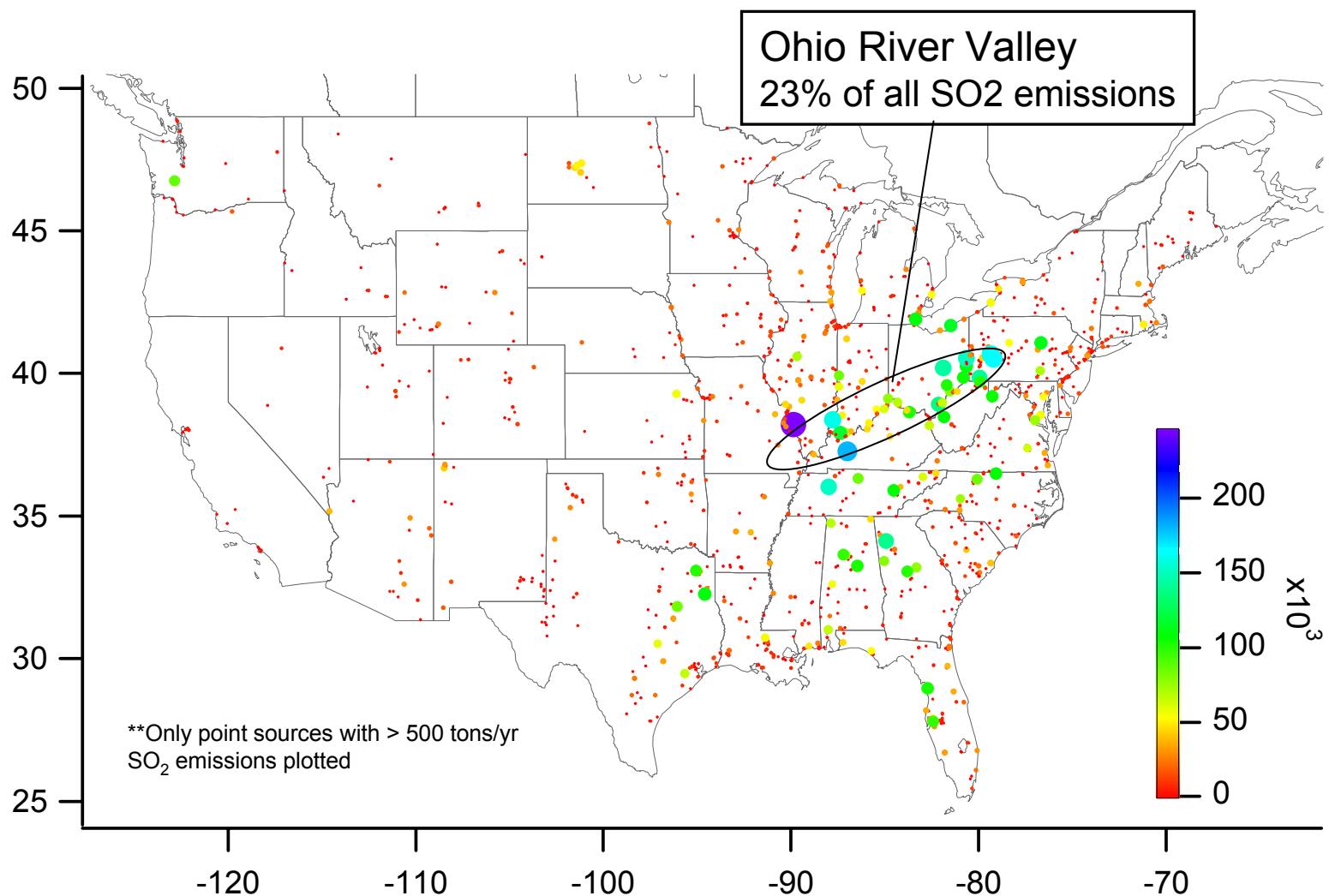
Fine Particle $\text{SO}_4^=$ Source ?

A Near-BL Analysis ($z < 2.2 \text{ km}$)

- Analyze legs below 2.2 km alt.
- Each BL pass = 1 data point
- Minimum 3 $\text{SO}_4^=$ measurements per pass, ~ constant altitude
- **Total of 79 BL passes analyzed (5 excluded)**

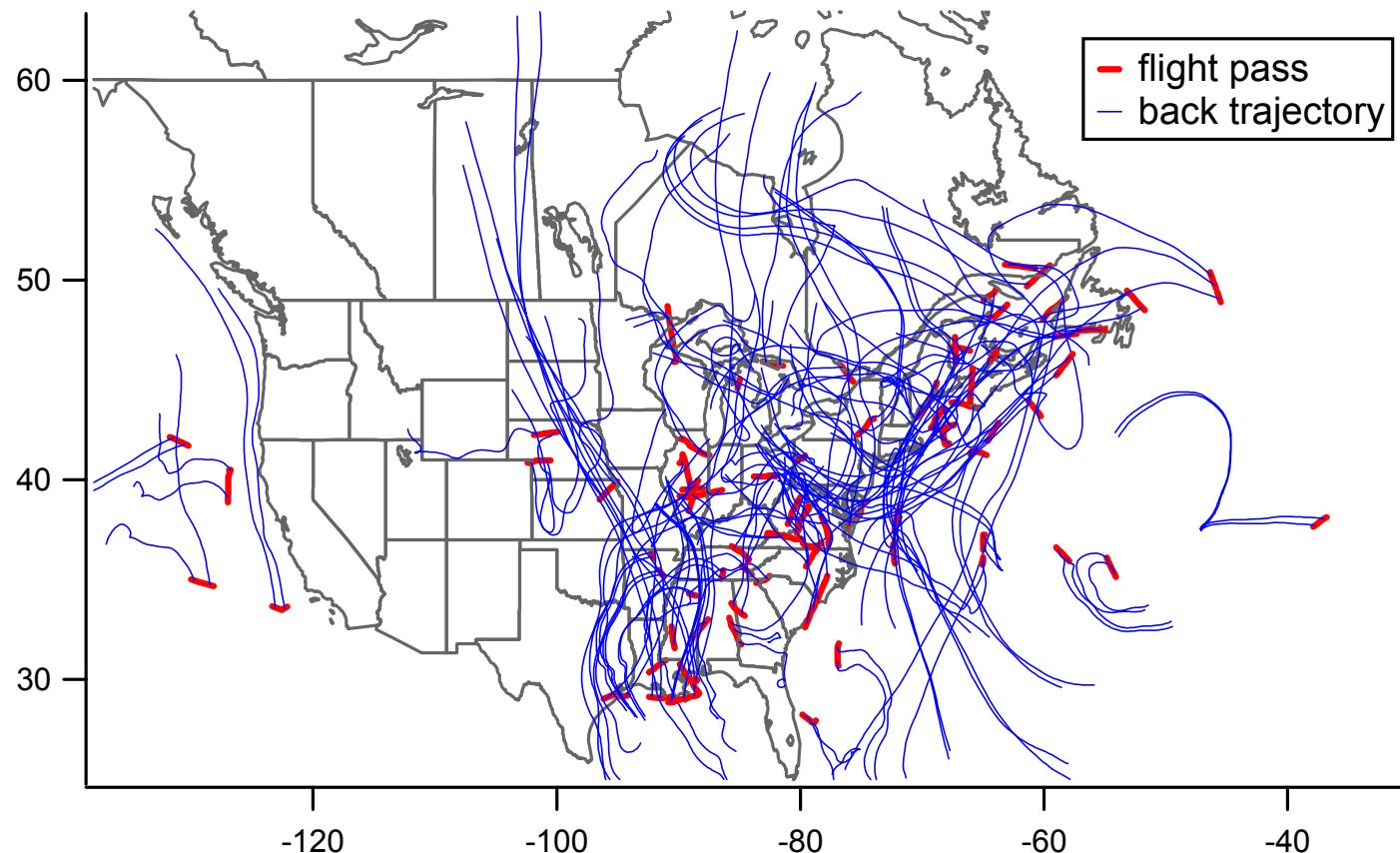


1999 SO₂ Emissions (tons/yr)



NOAA HYSPLIT

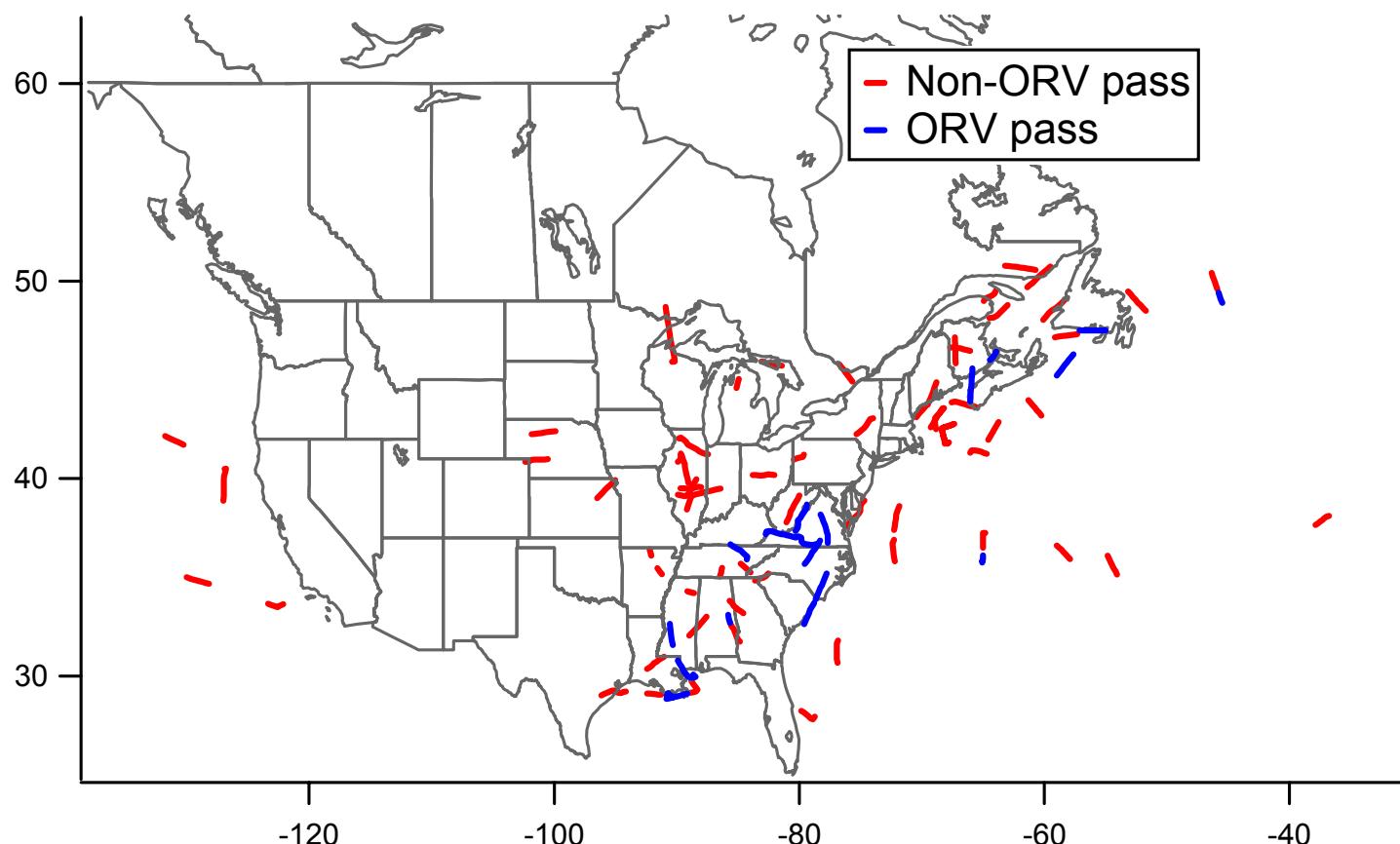
3-5 day back trajectory for each DC-8 BL pass



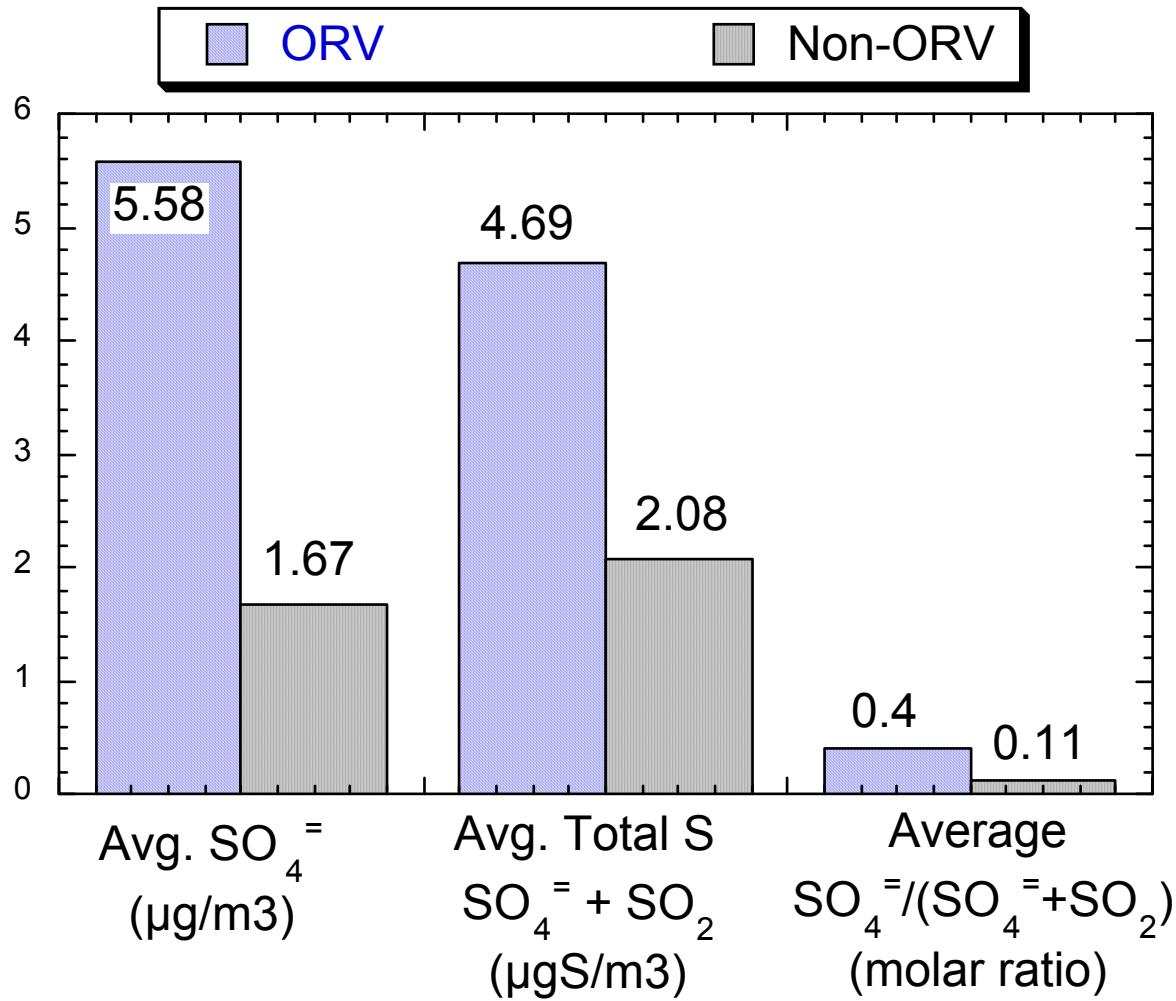
Back Trajectories Analysis for DC-8 Legs, Alt. < 2.3 km

79 BL passes analyzed
(67 are East of Miss. R.)

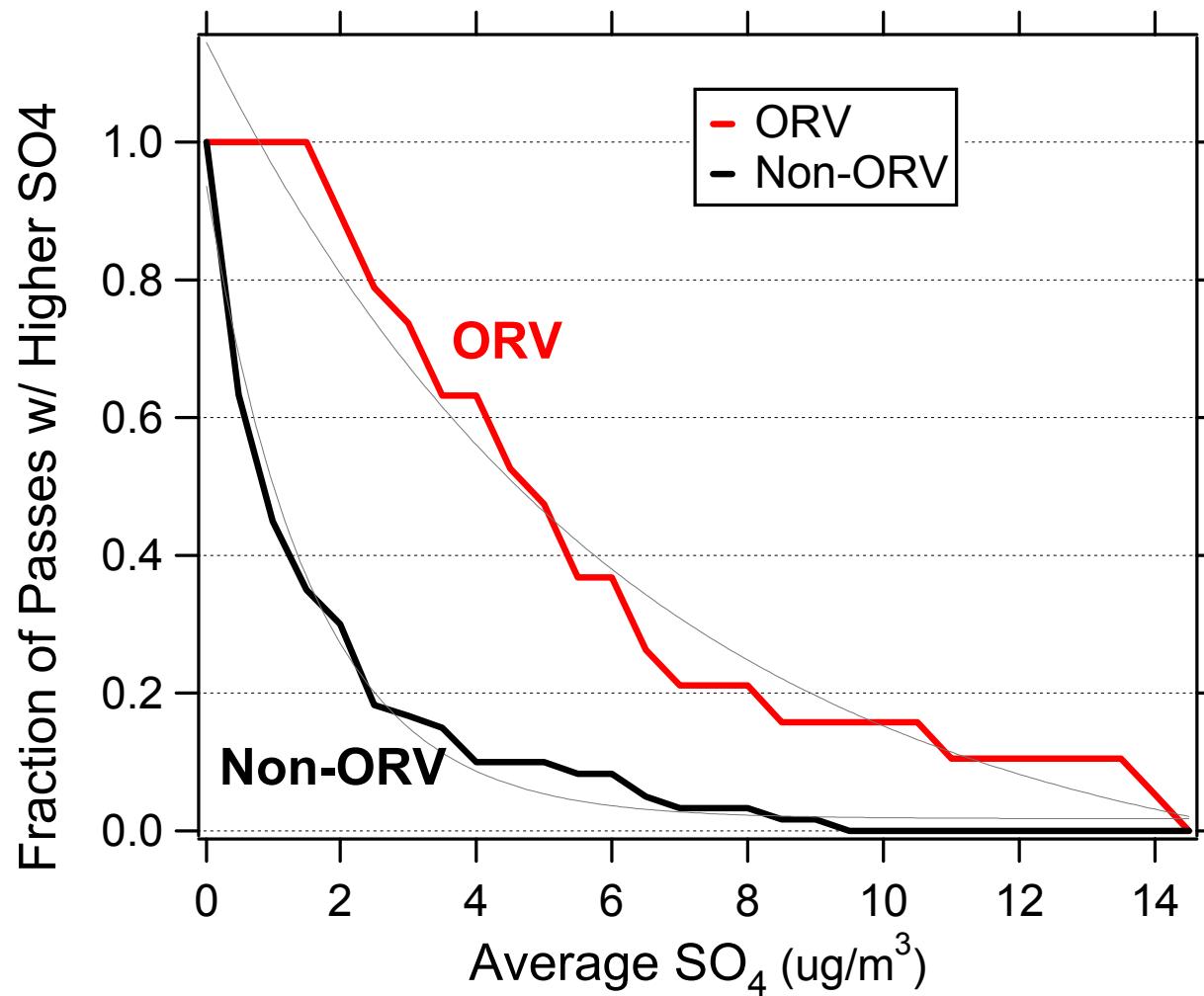
60 Non-ORV
19 ORV, 25%



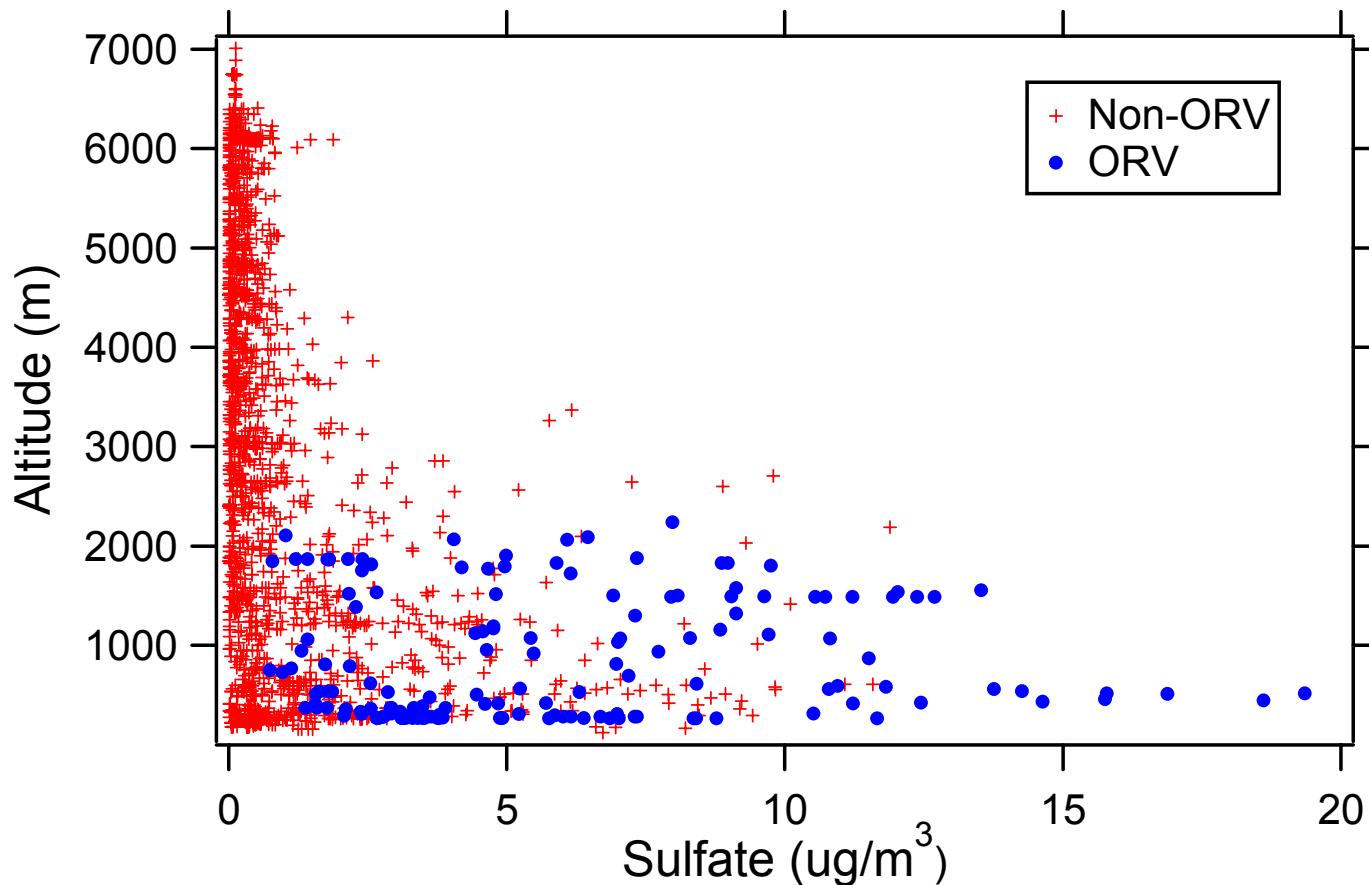
ORV vs. Non-ORV results



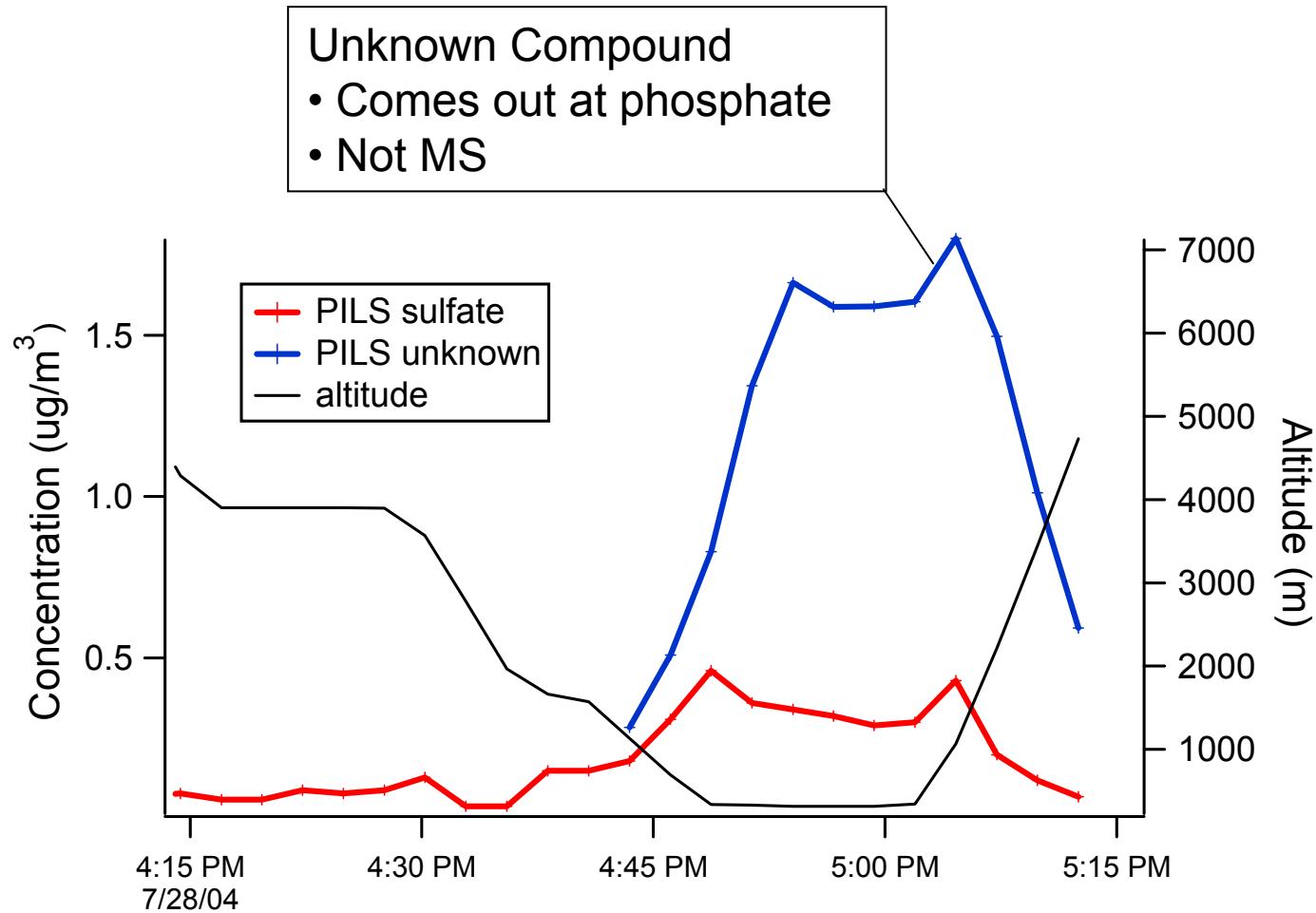
Distribution of sulfate concentration below 2.2 km



Altitude vs. SO_4 : Ohio RV vs. Non-Ohio RV

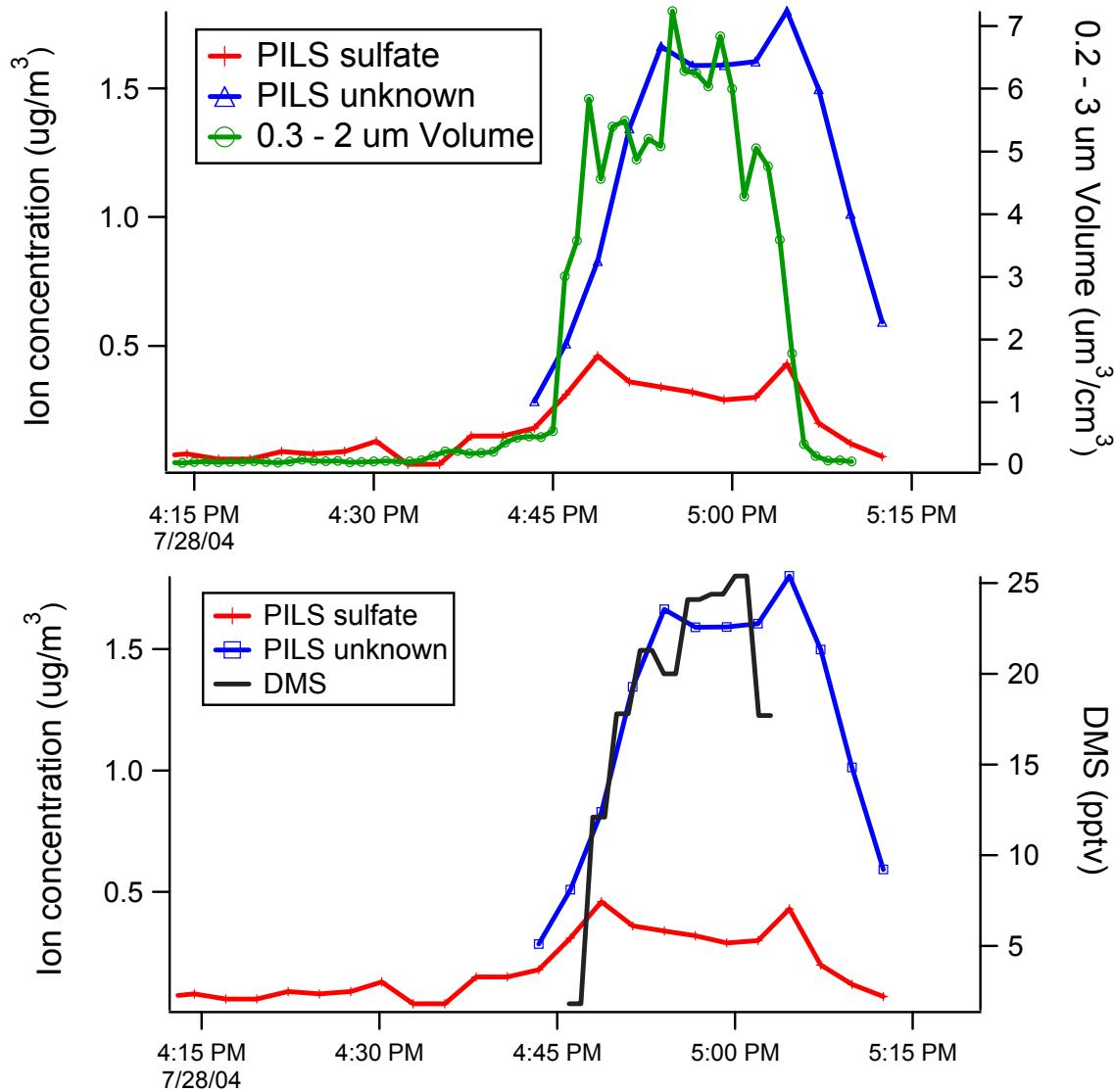


A Unique Compound Observed During Azores Intercomparison Flight 7/28/04



$\text{SO}_4^{=}$: AMS significantly higher than PILS; generally not observed

Unknown Compound Correlates with "Fine"-Particle Volume and DMS



Summary

- Sulfate: dominant fine inorganic aerosol species measured in summer 2004 INTEX-NA (and NEAQS-ITCT 2004) study
 - Highest at low altitudes
 - DC-8 most often $(\text{NH}_4)_2\text{SO}_4$ (neutralized), not observed on NOAA P3
- Air masses that passed through the Ohio River region contained, on average, 3 times as much $\text{SO}_4^{=}$ (twice as much total S) as those that did not, (observed widely east of Miss. R.).
- Unidentified "fine particle" constituent observed in marine BL
 - Concentrations could be higher than SO_4^{2-} .
 - May be some marine sulfur compound.